London provided with a body of superior Professors, who would not merely add to its distinction by their own labours and public instruction, but would guide the studies and researches of the young graduates. With the right men for Professors, and such picked students as the vast area of London would supply, I do not doubt that the reputation of the University of London would at no distant date rival that of any in the world. I hope Prof. Karl Pearson will forgive me if I appropriate in this connection a portion of his letter in the *Academy* of December 19:—

"The professorships ought to be the best in England, and the chief posts, at any rate, might remain in the gift of the Crown; the laboratories and libraries ought to be the best equipped in the Kingdom, and the University ought to draw students and investigators, not only from the five millions of London, but from the Greater Britain over the seas. Such a University would not only be able to retain in London men like Burdon-Sanderson, Seeley, Gardiner, Sylvester, and Lankester, but it would bring others there."

With the main idea expressed in these words with so much enthusiasm I most heartily agree. But I think those understand their countrymen and the possibilities of things best who would use, as I would, the existing University as a foundation. It has deserved well of the State; it has done its appointed work in the past well: instead of abusing it, we should strive to remove its defects, and give it higher work to do.

Two possible objections to my proposition may be considered. It may be said that such professorships are not wanted in London because such professorial teaching is supplied by Oxford and Cambridge. My reply is, that only a small portion of the population pass through those Universities, and London would draw from a much larger field. Again, it may be objected that the Professors of the existing teaching institutions in London would object to the creation of posts of a superior grade. On the other hand, such posts might stimulate ambition; they would be the prizes of the academic career. To object to them seems to me as reasonable as for a stuff-gownsman to object to the existence of judges, or for a curate to that of bishops.

The depletion of London of its most distinguished teachers, which continually goes on, is a real loss to its intellectual life. Dr. Dollinger says:—

"The force which moves the world, that which brings on the important crises in the history of mankind, is not to be found in material interests and passions, but in the great ideas which it is the business of Universities to work out."

Why should London, of all places in the world, dismiss from its midst, as it has long continued to do, those whose gift it is to open up most successfully new territory in the unknown world of knowledge? Yet the depletion goes on. Not one of the five officers of the Royal Society is at the moment resident in London. The President attends its meetings from Glasgow, and the Senior Secretary from Cambridge.

I must say a word about Gresham College. The promoters of the Albert University, whose untiring energy would be invaluable in a better cause, have, no doubt, done a clever thing in securing the adhesion of this obsolete institution to their scheme. Years ago I attended one of the prelections with two friends. The Dean of Manchester favoured, very unwillingly, an audience composed of ourselves and a few casual passers-by, whipped in apparently by the beadle, with a demonstration of Euclid I. 47, in the Latin tongue. Yet the institution which had descended to this mere husk of formality had once, if tradition is to be believed, been one of the most famous seats of learning in the world, and Francis I. is said, in emulation of it, to have founded the Collège de France in Paris. I believe the present Gresham Professors are not quite so sleepy as they were; but the contrast between the two rival institutions is more than melancholy. That Gresham College can nowadays clothe its dry bones and live is more than doubtful. It is, no doubt, only too glad to undertake the "teaching" department of the new University, which proposes to carry on its examining work in the empty building in Basinghall Street.

Kew, February 20. W. T. THISELTON-DYER.

A PRELIMINARY STATEMENT OF AN INVESTIGATION OF THE DATES OF SOME OF THE GREEK TEMPLES AS DERIVED FROM THEIR ORIENTATION.[1]

MR. LOCKYER has made out I think quite satisfactorily that the Egyptian temples were so oriented that the rising or setting of some conspicuous star on or near the axis of the temple, and visible from the adytum, would give warning of sunrise; and he applied to me for particulars of Greek temples for the purpose of seeing if there was any analogy, and the comparison appeared to promise a favourable result. Mr. Lockyer had found, before he had proceeded far in these studies, that he had been anticipated to a considerable extent by Herr Nissen, of Bonn, who has published several articles on the subject in the *Rheinisches Museum of Philologie*, and has brought within his scope both the Egyptian and the Greek temples. There is room, however, in the inquiry for a distinct work on the Greek temples, and especially with the help of more exact measurements of the orientation angles than Herr Nissen has made use of; as he appears to have contented himself with magnetic bearings—which are liable to considerable local variations, which are sufficient in an inquiry like the present to vitiate many of the conclusions that may be founded on such measurements—and there is a want of recognition of the influence of an elevated horizon. I had taken, in several instances, astronomic observations with a view to the more exact orientation of different temples, but something more is wanted even in the case of most of these—namely, the apparent altitudes of the mountains in the directions of the axes of the temples. I wish also to add that, but for Mr. Lockyer's suggestion, I should probably not have carried the inqury further than I already had done.

The great value of the inquiry lies in this: that it offers a means of determining, within tolerably close limits, the date of the foundation of a temple—not, perhaps, in most cases (although in some I believe it does) of the very structure which we now see, but of an earlier foundation on the same site. The key to the chronology lies in the movement of the stars with reference to the local horizon, owing to what is called the precession of the equinoxes. The object the ancients had in using the stars was to employ their rising and setting as a clock to give warning of the sunrise, so that on the special feast days the priests should have timely notice for preparing the sacrifice or ceremonial, whatever it may have been:

> "Spectans orientia solis
> Lumina *rite* cavis undam de flumine palmis
> Sustulit," &c.

The inquiry, even in its present state, is sufficient to establish a very high probability that the principle is a true one. There is nothing vague about it. It has to be kept within very severe limits, and it holds good nevertheless.

No stars can be accepted except from among the brightest, unless conspicuous star groups may have been used instead. Again, of single stars, only such can have been used for orientation in Greek temples which during a period not incompatible with reasonable archæology rose or set very near the line of the sun's course at some period of the year; and a further restriction is this, that the rising or setting must be just so far in advance of sunrise as to enable the star to be seen from the adytum of the temple, and, at the same time, not preceding it by any longer interval than is necessary.

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[1] Being the substance of a paper read to the Society of Antiquaries on February 18, 1892.

If, in addition to this, we find, as is frequently the case in the Egyptian temples, and is not without parallel in Greece, that as the star to whose point of rising or setting the axis of a temple was first aimed worked away from its then position by *precession*, either the doorway of the temple was altered, or a new temple founded alongside, so as to retain the desired observation; and in every case of such new temple being so built it is found to have followed the same cult as the original; if, in addition to this, in different provinces temples are found of which the cult is known, and which are so planned as to be able to use the same star—with such decided differences of orientation, however, as were prescribed by latitude and the local circumstances of the surrounding heights—we obtain a further strong corroboration, and one that will in many cases be sufficient to determine the cult, where this has not been otherwise pointed out.

One further step requires to be taken to occupy the ground with perfect confidence—viz. to inquire what analogy is there between the days of the month when the sun would rise ushered in, as it may be said, by the temple's peculiar star, and the days of the festivals as derived from historical sources. In this comparison we must not expect a coincidence on every point.

The date of the temple foundation in many cases is pre-Homeric, whilst the basis of the historical account of the date of the feast is probably post-Persic. There may have been an interval of nearly 1000 years between the two, so that there is room for changes. Again, owing to their double system of reckoning months and years, considerable variation in the dates given by Mommsen, whose authority I mainly follow, is quite possible; and besides this, in some of the cases given below, the orientation day, if I may so call it, may be in fault one or possibly two days for want of the exact particulars of the site to which I have made allusion.

Firstly, speaking of Attic feasts, the great temple at Eleusis is an example very much to the point. The star which seems to have determined the orientation is Sirius, shining as it rose at midnight along the axis of the temple on September 14. The Eleusinian mysteries are stated to have commenced on the 16th of that month. In this case the sun was not looked for; the weird light of the star reflected from some combination of jewels was more likely to have been suited to the mysteries. It is perhaps less likely that this ceremony would have been changed than in most of the other cases.

The axis of the older Erechtheum had the central star of the fine constellation Aquarius setting heliacally on August 9.	The lesser Panathenaia, dated August 13–14.
Warning of the sunrise at Sunium was given by the setting of the Pleiades on October 20.	A feast to Minerva and Vulcan is dated October 30.
The star α Arietis rose heliacally to the older Olympieium at Athens, April 2, more than 1000 years B.C.	The feast Olympia is recorded for April 19 in later times.
The temple of Diana Brauronia on the Acropolis of Athens agreed with the rising of Aquarius (the central star ζ Aquarii in particular) on February 21 at the presumed date of its foundation.	The Little Mysteries were celebrated February 21.—N.B. A temple of Diana was in close connection with the great temple at Eleusis.

In the earliest times, as already explained, the stars were used as the only available clocks, but probably by the end of the sixth century, whether by the discovery of the behaviour of the stars or by the invention of the water-clock (which is recorded to have been used to some extent in the fifth century), or other approximate means of measuring time, the dependence on the stars alone had ceased; and the later temples, in Greece at any rate, appear to have been built without any reference to these.

At Athens this applies to the existing or new Erechtheum, the Theseum and the temple of Nike Apteros, which temples do not seem to have been built parallel to any old foundations. The old foundations under the Erechtheum have a very different angle. The sunrise, however, was considered in these just as much as before, for owing to the artistic instinct of the Greeks, they seem invariably to have secured for their principal festivals the fine effect of the first sunbeam on the statue; but as all the temples, whether old or new, admitted of two axial coincidences with the sunrise—one which might have a clock star (as it may be called) to announce the dawn; the other, except by rare accident, having none, the desired effect would have been attained on both occasions when the sun had the same declination.

It will be obvious that if the axis of a temple in any latitude had been directed due east (the horizon also being level), the rising sun would coincide with it at both the spring and autumn equinoxes. Similarly every other amplitude would have two solar coincidences (provided that is, in accordance with what has just been stated, the axis fell within the solstitial limits). When it had been found that the precessional movement had taken away the star from the direction of the axis, there would have been no reason for preferring one of these solar coincidences to the other, and the feast could have been shifted to a different date if it had been thought more convenient. It would appear that something of this sort may have taken place at Athens, for we find on the Acropolis the Archaic temple, which seems to have been intended originally for a vernal festival, offering its axis to the autumnal sunrise on the very day of the great Panathenaia in August.

The Chryselephantine statue of the Parthenon, which temple followed on the same lines as the earlier Hecatompedon (originally founded to follow the rising of the Pleiades after that constellation had deserted the Archaic temple alongside), was lighted up by the sunrise on the feast to the same goddess in August, the Synæcia, instead of some spring festival, for which both these temples seem at first to have been founded.

The temple at Sunium, already quoted for its October star-heralded festival to Minerva, was oriented also axially to the sun on February 21, the feast of the lesser mysteries.

Of temples of later foundation we have the following for which no suitable stars can be found:—

The Erechtheum, its sun axis days are March 2 and September 4, the latter being the date of the *Niceteria*, the special festival of that temple, supposed to record the celebrated contest between Minerva and Neptune, considered to have been on September 3. Another instance is the Theseum.

The *Thesea* are put down for October 8–9. The sunrise theory points out either March 7 or October 7. Does not this fact restore the disputed title of Theseus to this temple?

There cannot be so much known respecting the feasts in the other provinces.

The Olympic games were held, according to most authorities, soon after midsummer, but by others in the autumn. I quote on Nissen's authority the following:—

420 B.C., Sept. 14.
416 B.C., Aug. 31.
412 B.C., Sept. 12.
408 B.C., Sept. 2.

The heliacal rising of the star Spica (α Virginis) seems to belong to the Heræum, and indicates September 15.

The Isthmian games took place either in May or

August, according to the Olympiad. The axis of the temple at Corinth coincides with the sunrise on both those months, but to only one of them (that of May) is a star applicable.

Further confirmation of the truth of this general theory—namely, that the amplitudes of stars determined the orientations of temples—lies in the fact that in the majority of instances, at any rate, the same star belongs to the same cult. I am satisfied that this can be established for the Egyptian temples. In Greece we find the following.

The star α Arietis is the brightest star of the *first sign of the Zodiac*, and would therefore be peculiarly appropriate to a temple of Jupiter. The heliacal rising of this star agrees both with the Olympieium at Athens and that at Olympia. There is a considerable difference in the deviation of the axes of these two temples from the true east; but this is exactly accounted for by greater apparent altitude of Hymettus over the distant Mount Pholœ.

The Pleiades are common to the following temples of Minerva, viz. the Archaic temple on the Acropolis, the Hecatompedon, and Sunium. In the two former it is the rising, the latter the setting star.

α Virginis or Spica must have been supposed to be sacred to Juno. The Heræum at Olympia agrees exactly with this view, and the Argive Heræum can be referred to no other; but, as the foundations of the earlier Heræum are not now visible, the exactness of the coincidence cannot be thoroughly established without re-excavating part of the site. There is nothing, however, inconsistent to this view in what is known about it. The nomenclature of the temple of Juno at Girgenti rests on a rather weak historical basis; but Spica entirely supports it.

There must have been something in common between the temples at Corinth, Ægina, and Nemea. The two last, at any rate, are reputed temples of Jupiter, and I have reason to think that also the Temple of Jupiter at Girgenti agrees with the same star—namely, Antares.

Approximate dates derived from the orientation of Greek temples.

Star.	Name of temple.	Place.	Month and day.	Year of foundation. B.C.	Star rising or setting.	No.
Pleiades (η Tauri) ...	Archaic temple of Minerva	Athens ...	April 20 ...	1495	R	1
	Hecatompedon temple of Minerva ...	Athens ...	April 25 ...	1120	R	2
	Temple of Minerva, Sunium	Sunium ...	October 20 ...	1125	S	3
Sirius	Temple of Ceres, Eleusis (for midnight mysteries)	Eleusis ...	September 14	1380	R	4
Fomalhaut (α Piscis Australis)	The same for sunrise	Eleusis ...	November 18	1350	S	5
Spica, *i.e.* α Virginis .	The Heræum, Olympia	Olympia ...	September 15	1300	R	6
	The Heræum, Argos	Argos ...	February ...	about the same time	S	7
	The Heræum, Girgenti	Sicily ...	September 15	1180	R	8
α Arietis	Jupiter Olympius, Athens (temple attributed to Deucalion	Athens ..	April 1 ...	1135	R	9
	Jupiter Olympius, Olympia	Olympia ...	April 3 ...	760	R	10
Antares (α Scorpii) ...	Temple at Corinth	Corinth ...	May 1 ...	700	S	11
	Jupiter Panhellenius, Ægina	Ægina ...	May 6 ...	670	S	12
	Nemea, Temple of Jupiter	Nemea ...	similar to	two last	S	13
Aquarius (ζ Aquarii)	Oldest temple at Epidaurus (the Hiero)	Epidaurus ...	July 29 ...	1270	S	14
	Older Erechtheum, Athens	Athens ...	August 9 ...	920	S	15
	Diana Brauronia	Athens ...	February 21	750	R	16
δ Corvi (?)	Temple of Themis, Rhamnus ...	Rhamnus ...	September ...	about 1150	R	17
	Temple of Nemesis, Rhamnus ...	Rhamnus ...	September ...	780	R	18

Temples of later foundation for which no heliacal star has been found.

	The Theseum	Athens ...				
	The new Erechtheum	Athens ...				
	The temple of Wingless Victory ...	Athens ...				

The above table of approximate results, which I have put together, must for the most part be considered preliminary, and subject to amendment when further particulars have been ascertained, which I am in hopes of being able to obtain in the course of the present season. Nevertheless, I do not think that as respects the examples mentioned in Nos. 1, 2, 9, 12, and 16, there will be much need of alteration, as of these I am already in possession, though not of all, yet of the most important measurements. Of the remainder I do not feel so confident, but there is still a good deal that can be pointed out in respect to some of them which is consistent with historical and architectural archæology.

Olympia must have been a sacred spot long before the Olympiads began to be dated, and the Heræum there appears to be the most archaic temple structure that exists in Greece. The date suggested by the orientation, 1300 B.C., does not seem unreasonable.

Then we come to the establishment of the Olympiads, which began 776 years B.C. Compare the date of the great Temple of Jupiter derived from its orientation, 760.

The temple at Corinth was thought by archæologists of the past generation to date from about the middle of the seventh century B.C. The date I get from its orientation is 700.

The temple at Ægina, it is evident from its architecture, is somewhat later than that at Corinth or the Olympian Jupiter. That is also the orientation view of the case. At the same time, I think that the interval between Nos. 11 and 12 ought to be more than thirty years. I rather expect that more exact measurements at Corinth will throw back somewhat the date of that example. Want of clear weather obliged me to be content with magnetic bearings at Corinth, and these may easily be at fault as much as 1°

F. C. PENROSE.